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BE IT KNOWN that I, *Dana PETTIGREW*, have invented
certain new and useful improvements in

***A SYSTEM FOR, AND A METHOD OF PUMPING
FLUIDS FROM A WELL***

of which the following is a complete specification:

-1-

BACKGROUND OF THE INVENTION

The present invention relates to a system for and a method of pumping fluids from a well.

5 It is known in the field of pumping fluids from deep wells to use submersible pumps which are driven by submersible pump motors. The pump motors are frequently of three stages including an upper tandem motor, a center tandem motor and a lower tandem motor. They are controlled from the surface by a diesel engine, driving a generator which in turn drives a variable speed drive. In the known systems and methods of
10 combining the tandem motors, horse power derived may be 500 hp. To double the power to 1000 hp and the subsequent volume of pumped fluids, it was necessary in the past to provide a 1000 hp tandem motor to be manufactured. It also required a larger diesel engine, generator and variable speed units, as well as a larger associated wiring due to high voltage and
15 amperage at much higher costs.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a system for and a method of pumping fluids from a well, which avoids the disadvantages of the prior art.

5 In keeping with these objects and with others which will be
come apparent hereinafter, one feature of the present invention resides,
briefly stated, in a system for pumping fluids from a well to a ground,
comprising a submersible pump introducible into a well for pumping fluids
from the well to ground; submersible motor means introducible into the well
10 and connected to said submersible pump for driving said submersible pump,
said motor means including at least one upper tandem motor mechanically
connectable to another motor and electrically connectable to a power source;
a power source connected to said upper tandem motor and supplying said
upper tandem motor with electrical power; and at least one additional upper
15 tandem motor; at least one additional power source connected with the
additional upper tandem motor for supplying electrical power to said
additional upper tandem motor, said additional upper tandem motor being
mechanically connected with said first mentioned upper tandem motor so as
to drive said submersible pump with a mechanical power derived from said

first mentioned upper tandem motor and said additional upper tandem motor, said power sources being independent power sources which independently supply electrical power to said upper tandem motors and also being unsynchronized power sources.

5 It is also another feature of the present invention to provide a method of pumping fluids from a well to a ground, comprising the steps of introducing a submersible pump into a well for pumping fluids from the well to ground; introducing submersible motor means into the well and connecting it to said submersible pump for driving said submersible pump, using in said
10 motor means at least one upper tandem motor mechanically connectable to another motor and electrically connectable to a power source; connecting a power source to said upper tandem motor and supplying said upper tandem motor with electrical power; using in said motor means at least upper tandem
15 motor; connecting at least one additional power source connected with the additional upper tandem motor for supplying electrical power to said additional electrical power, mechanically connecting said additional upper tandem motor with said first mentioned upper tandem motor so as to drive said submersible pump with a mechanical power derived from said first mentioned upper tandem motor and said additional upper tandem motor,

selecting said power sources to be independent power sources which independently supply power to said upper tandem motors and which are also also being unsynchronized power sources.

5 When the system is designed and a method is performed in accordance with the present invention, they are characterized by increased power and volume pumped and at the same time require only duplicate, existing, above ground equipment, rather than a larger equipment.

10 The novel features which are considered as characteristic for the present invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a view showing a system for and a method of pumping fluid from a well in accordance with the prior art;

5 Figure 2 is a view showing a system for and a method of pumping fluid from a well in accordance with one embodiment of the present invention;

Figure 3 is a view showing details of the system and method of Figure 2, on an enlarged view;

10 Figure 4 is a view showing an adaptor and a shorting ring of the inventive system and method, in a perspective view; and

Figure 5 shows a further modification of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 shows a conventional system for pumping petroleum from a well 1. The system includes a centrifugal pump 2 having an intake 3, which takes a fluid flow from a formation 4 and pumps it through a pump discharge 5 to a surface. The centrifugal pump is driven by a motor unit which includes an upper tandem motor 6, a center tandem motor 7 and a lower tandem motor 8. The motor unit can be provided with a motor protector 13. The tandem motor 6, 7 and 8 are mechanically connected with one another. For example, their shafts are mechanically coupled with one another. The tandem motor 6, 7 and 8 are also electrically connected with one another in series. In other words, their electrical systems are connected with one another as known in the art and not shown in the drawings.

An electrical power supply to the motor unit is performed from a single power source which can include a diesel engine identified with reference numeral 9, a generator 10 which is driven by the diesel engine, and a variable speed drive 11 which is driven by the generator. A single electrical supply line 12 extends from the thusly formed power source only to the upper tandem motor 6. Then the current is supplied in series to the center tandem

motor 7 and the lower tandem motor 8 due to the electrical connection of the tandem motor 6, 7, 8 with one another.

Figure 2 shows a system for pumping fluid from a well 1 in accordance with the present invention. The parts of the inventive system which are identical with the parts of the system of Figure 1 are identified with the same reference numerals. The inventive system also includes a centrifugal pump 2 which through its intake 3 takes fluid flowing from the formation 4 and discharge it through the pump discharge 5 to the ground. The system also includes the upper tandem motor 6 which is supplied with power from the diesel engine 9 through the generator 10 and the variable speed drive and through the electrical line 12. In the inventive system instead of the conventional center tandem motor 7 which is only mechanically connected to the upper tandem motor 6, another upper tandem motor 17 is provided. The term "upper tandem motor" is utilized here to define a tandem motor which is not only mechanically connected to another motor, but also is separately connected to a power source to be separately supplied with electric power.

As can be seen from the drawings, the second upper tandem motor is supplied with power from a power supply unit including for example

a diesel motor 19, a generator 20 which is driven by the diesel motor 19, a variable speed drive 21 which is driven by the generator 20, and an electrical supply line 22 extending from the variable speed drive 21 to the second upper tandem motor 17. The upper tandem motors 6 and 17 are connected with one another only mechanically, for example by coupling of their shafts with one another. However, they are supplied with power from independent power sources 9, 10, 11, 12 and 19, 20, 21, 22, which are independent from one another and are synchronized or unsynchronized with respect to their electrical parameters. The upper tandem motors 6 and 17 together form a so-called tandem/upper tandem motor. The system also can include other conventional tandem motors.

Figures 3 and 4 show some details of connection of the upper tandem motors 6 and 17. In order to connect the upper tandem motors with one another, an adaptor 31 is provided. The adaptor 31 has an upper flange 32 with a plurality of holes into which not shown bolts extending through corresponding holes in a lower flange 33 of the upper tandem motor 6 can extend so as to connect the upper flange 32 of the adaptor 31 to the lower flange 33 of the upper tandem motor 6. The adaptor 31 has a lower flange 34 which is also provided with a plurality of holes for passing of bolts which extend through an upper flange 35 of the upper tandem motor 17 for

connecting the lower flange 34 of the adaptor 31 to the upper flange 35 of the upper tandem motor 17. A shorting ring 36 provided with a plurality of hollow projections 37 can be arranged between the upper flange 32 of the adaptor 31 and the lower flange 33 of the upper tandem motor 6. The hollow projections 37 serve for connection of electrical cables from the tandem motor 6 as a common termination point as known in the art.

The system further has a connecting element 38 for mechanically connecting shafts of the upper tandem motor 6 and 17 with one another. The connecting element 38 includes a shaft portion 39 provided with an upper coupling 40 which is connectable to the shaft of the upper tandem motor 6 and a lower coupling 41 which is connectable with the shaft of the upper tandem motor 17. When the connecting element 38 is installed in the system, the shafts of the upper tandem motor 6 and 17 are mechanically connected with one another.

The system further has a switch 42 for turning on and off a power supply from the power source 9, 10, 11, 12, to the upper tandem motor 6, and a switch 43 for turning on and off a power supply from the power source 19, 20, 21, 22 to the upper tandem motor 17. The switches 42 and 43 are connected with one another so that they operate jointly, in other

words for simultaneously turning on and off a power supply to the upper tandem motor 6 and the upper tandem motor 17.

5 While Figures 3 and 4 show connecting means including an adaptor, it is to be understood that other connecting means can be provided as well. For example the corresponding parts of the upper tandem motors can be formed so that they can be directly connected with one another without intermediate elements. It is also to be understood that the motor unit of the present invention can be provided with a greater number of tandem motors. It is believed that the operation of the inventive system is
10 understood. When the tandem motors are supplied with electrical power from the power sources, they jointly drive the centrifugal pumps which pumps fluid from the well to the ground.

Figure 5 shows another embodiment of the present invention.
Here both upper tandem motors 6 and 17 are supplied with electric power
15 from the same power source 9, 10, 11, but for example through separate electrical lines 12, 22, thus separately receiving electrical power.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

5 While the invention has been illustrated and described as embodied in a system for, and a method of pumping fluid from a well, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

10 Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention.

15 What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.